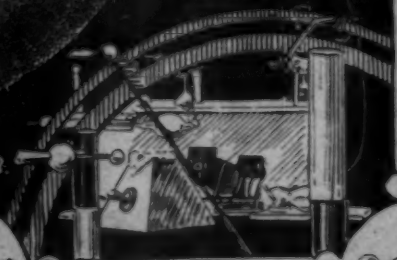
Vol. 7. No. 3. September, 1900.

THE AMERICAN X-RAY JOURNAL

A MONTHLY DEVOTED TO THE PRACTICAL APPLICATION OF THE NEW SCIENCE AND TO THE PHYSICAL IMPROVEMENT OF MAN.



HEBER ROBARTS M.D., M.E. EDITOR.
SUITE 310 CHEMICAL BUILDING.
ST. LOUIS, MO.

The Test of Time and Experience.

30 Years of Confidence

on the part of the profession, has established beyond all question that

Syr. Hypophos. Co., Fellows

is the

Remedy—Par Excellence

in Anaemia, Neurasthenia, Bronchitis, Influenza, and during Convalescence after exhausting diseases.

Contains—Hypophosphites of Iron, Quinine, Strychnine, Lime, Manganese, Potash. Each fluid drachm contains the equivalent of 1-64th grain of pure strychnine.

Special Note.—Fellows' Hypophosphites is advertised only to the Medical Profession; is *Never Sold in Bulk*, and Physicians are cautioned against worthless substitutes.

Medical Letters may be addressed to

Literature of value upon application. MR. FELLOWS, 48 Vesey Street, New York.

Sparks Every Day

RAIN OR SHINE

Does not change Polarity while in operation.

Greatest Generating Capacity.

Highest Vibratory Current.

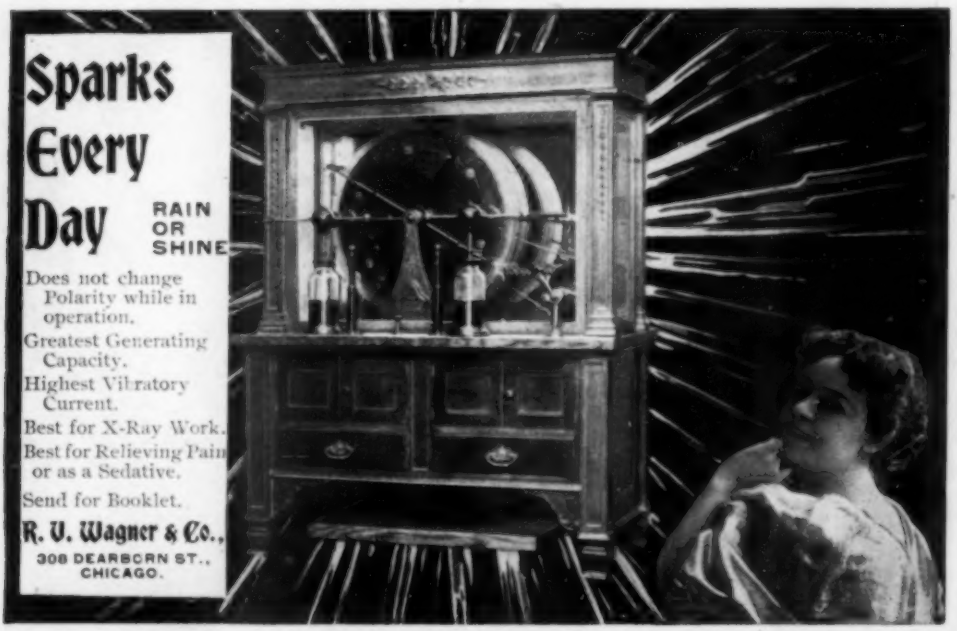
Best for X-Ray Work.

Best for Relieving Pain or as a Sedative.

Send for Booklet.

R. U. Wagner & Co.,

308 DEARBORN ST., CHICAGO.



THE AMERICAN

X-RAY JOURNAL.

Devoted to Practical X-Ray Work and Allied Arts and Sciences.

PUBLISHED MONTHLY BY THE AMERICAN X-RAY PUBLISHING COMPANY.

HEBER ROBARTS, M. D., M. E., Editor.

SUBSCRIPTION RATES—IN ADVANCE.

United States, Canada and Mexico .....$1 00 | Foreign Countries $2 00
Single copies ..... 15 | Single copies 20

Editorial matter should be addressed to Dr. Heber Robarts, Editor, 310 Chemical Bldg., St. Louis. All business matter should be addressed to The American X-Ray Publishing Co., same address.

Contributors of original articles and other matter relative to X-Radiance, of interest to the medical profession, are solicited from all parts of the world. Contributors will be furnished a liberal number of extra copies of the Journal containing their article. Reprints furnished by request.

Translation of articles written in German, French and Spanish is made by Frank Ring M. D., 611 Chemical Building, St. Louis.

Entered at the postoffice at St. Louis, Mo., as second-class matter.

VOL. 7. ST. LOUIS, SEPTEMBER, 1900. NO. 3.

CONTENTS VOL. 7 NO. 2.

Roentgen Society of the United States. By Dr. J. Rudis-Jicinsky.

Excitation of the Crooke's Tube by the Static Machine. Chapter VII, by Dr. J. T. Pitkin.

X Ray Burns. By J. N. Scott, M. D.

Pro Et Contra. By J. Rudis-Jicinsky, A. M. M. D.

Static Machine. By Y. M. G. Beard.

Answers to Inquiries.

Roentgen Rays for Examining Coal.

"Archives of the Roentgen Rays."

Generalized Cathode Rays.

Becquerel Rays.

The Roentgen Society, London.

CONTENTS VOL. 7 NO. 3.

Excitation of the Crooke's Tube by the Static Machine. Chapter VIII, by Dr. J. T. Pitkin.

Therapy of Encephalocele.

The Pathology of Fracture of the Lower Extremity of the Radius.

Missouri School for the Blind.

Negatives Developed in Light.

Discontinuity of Cathode Radiation.

Home Made Static Machine.

Answers to Inquiries.

The Downfall of the Atomic Theory.

The Roentgen Rays with Associated Phenomena and their Application in Dentistry.

Book Reviews.

ARTHUR W. GOODSPEED, Ph. D.

Assistant Professor Physics, University of Pennsylvania, Philadelphia.

The American X-Ray Journal.

Devoted to Practical X-Ray Work and Allied Arts and Sciences.

VOL. 7. *ST. LOUIS, SEPTEMBER, 1900.* *NO. 3.*

EXCITATION OF THE CROOKE'S TUBE BY THE STATIC MACHINE.

Static Magnetism.

By John T. Pitkin, M. D.

Chapter VIII.

When a pebble or other missile is thrown into a pond of water, an eccentric wave extends outwards from the point of contact of the projectile, in a circular direction, with a force which varies inversely as to the square of the distance.

During the period of agitation the water does not travel forwards, it only rises and falls, the mechanical force alone is propagated. In a similar manner an electrical conductor surrounded by air, excited by a static machine, a dynamo or a battery, causes the establishment of vortex motion called magnetism in the environment; here again, the medium (the atmosphere) does not travel outwards, the energy only is transmitted.

In the differenciation between static magnetism (Electro-static lines of force of the older writers) on the one hand, and static electricity on the other, the student should ever bear in mind that, whereas, in the passage through air, the former goes through the medium by contiguity, the latter carries the medium along with it. The former is invisible; the latter can be seen in a darkened apartment as a spark, glow or brush discharge. Magnetism can be felt as a slight pulling or pushing force. Electricity is palpable as a draft, wind, spray, breeze, cobweb feeling, or sudden shocks of varying intensity. Magnetism is silent; electricity audible, from a low, crackling or sibilant sound, to the loud detonations of lightning.

The atmosphere surrounding our earth may be considered as a huge magnet, the excited static machine has a similar envelopment. As the glass plates are better conductors of magnetism than air, the lines of force converge upon their surfaces, they are conveyors of a proportionately large amount of magnetic energy.

Metallic conductors presented to the magnetized plates, become recipients of a convective electrical flow.

After the machine has been in action a few moments, the glass plates reach a condition of excitation called magnetic saturation, which represents the maximum volume of energy primarily obtainable from a given apparatus; this amount is invariable, and independent of the speed at which the instrument is operated. In this condition it is supposed that the molecules of glass have been completely polarized.

Whereas, in the low tension, direct current electrical machines called dynamos and motors, the electro-magnets constituting the fields are usually placed laterally, one on either side. In the construction of the high tension, direct current generators called static machines, the fields are usually made up of two sets of oblong glass plates, and one set is placed above the

other. The revolving electro-magnet of the dynamo, or armature, finds its analogue in many glass wheels of uniform size and composition seperated from each other by washers all of which are firmly fastened together, and revolve en masse upon a common axle. The revolving plates vary from two to sixteen in number and from twenty-eight to thirty two inches in diameter. The washers are usually circular pieces of wood from four to six inches in width, one half of their number are one half of an inch thick, the remainder are about one inch in

FRAGMENT OF A NEEDLE IN THE KNEE JOINT.—Skiagraph taken with a Holtz machine, having twelve revolving 28-inch plates; two half-inch spark gaps in circuit.

transverse dimension. Thick and th'n washers alternate with each other in position upon the axle, they seperate the glass wheels and provide interspaces beyond their free margin for the reception of stationary structures.

Corresponding to the thick washers are intervals into which the collecting combs and their supporting rods extend. Each narrow interspace is for the reception of one superior and one inferior stationary plate. As wood is a fairly good conductor of static electricity and liable to divert a portion of the current, some makers cover the steel shaft with a hard rubber tube or sleeve, this prevents the revolving plates from making a metallic contact which could dissipate their magnetism and insullates the axle from disruptive discharges. Other makers invest the exterior of the washers with hard rubber to lessen the tendency to internal electrical discharges not only into the axle but also between the comb holders of opposite sides favored by the circular pieces of wood, when the external current meets with considerable resistance. Solid hard rubber washers placed over a rubber-clad axle would provide the most effectual means of overcoming leakage into the axle, lessen the tendency to internal disruptive discharges when the machine is in operation and assist the revolving plates to retain their residual magnetism during inaction. In the excitation of the Crooke's tube by the static machine, with a new, soft tube, of low vacuum, in sample series the composition of the washers is of little consequence but after the tube has become hardened by use or if resisting spark gaps are placed in the circuit it may be of prime

importance. In the construction of a static machine for x-ray purposes cost of material should be a secondary consideration.

All of the plates of the Holtz machine, stationary and movable, are made of the selected thinner grades of double thick, annealed, crystal, dielectric glass; they should have several coats of varnish, shellac and amber to overcome their hygroscopic tendency. When not well coated the residual magnetism may treak away during periods of repose, the charge is lost, and a Toepler, a Wimhurst or other secondary device becomes necessary to bring the machine into action. The tendency to loss of charge is greatest during the heated term when the atmosphere is surcharged with humidity and reaches the highest point of fractional saturation. Loss of charge may usually be prevented if the following directions are followed. In the construction of the machine all of the plates should be free from metallic or other good electrical conductors, their occluded moisture driven out by heat, the pores well filled with amber varnish and shellac and their exterior covered with the same material.

The instrument proper inclosed within a tight case kept dry by measures previously described. In operating the instrument, always turn the revolving discs towards the points of the serrated margins of the semilunar metallic conductors which project from the stationary plates at either end of the apparatus, if allowed to run in the opposite direction the charge is usually dissipated. Give the instrument daily use. Let the Leyden jars rest upon large glass plates. Leave the discharging rods wide open at night. The prime conductors, jars or discharging rods rods should not be handled after the machine has ceased to operate. Multiplicity of plates favors retentivity.

The more simple Holtz machines have a single upper and a single lower stationary plate on either side of which a movable wheel revolves. In the more modern complex machine employed for x-ray work the number of revolving plates has been increased to sixteen, representing eight simple machines, inclosed within a single case, operated in multiple relationship to each other. The writer is the proud possessor of such an apparatus.

In the excited static machine one set of stationary plates is charged with positive, the other with negative magnetism. As the revolving discs pass by the stationary fields, their presented surfaces become inductively charged with the opposite polarity, e. g., if the superior stationary plates are negative, the uppermost half of the wheels will be positive, conversely the inferior plates being positive the corresponding segments of the revolvers will be negative. The two sets of stationary plates are seperated from each other by an intervening atmospheric space, four or five inches wide, called the window of the machine. At either end of the instrument, extending into the window, are placed electrical conductors, which serve to relieve the revolving discs of the energy accumulated during each semi-revolution.

BUFFALO, N. Y.

THERAPY OF ENCEPHALOCELE.

In the International Medical Magazine for April 1900, Dr. Carl Beck has contributed an excellent article entitled "Contribution to the Therapy of Encephalocele." The article contains ten electros, two of which are radiographs showing to what extent the tumors connects with the cerebral mass. After describing in his masterly style the diagnostic features of meningocele and hydrencephalocele Dr. Beck takes up encephalocele proper and says:

"The contents of encephalocele proper consist of solid cerebral tissue. While in the large majority of cases differentiation is easy, great diagnostic difficulties are sometimes offered, just as in spine bifida; and as in spine bifida it was reserved to the Roentgen rays to clear up some doubt-

ful points, especially the question of the size of the opening in the bone and the presence and expansion of the cerebral substance. (The value of the x-rays in the dignostic condition of spina bifida was printed in the American X-Ray Journal.)

It goes without saying that the rays are also useful in differentiating angioma, lipoma, soft sarcoma and cephalhematoma from serous and dermoid cyst. The article is original and deserves the careful study of surgeons.

THE PATHOLOGY OF FRACTURE OF THE LOWER EXTREMITY OF THE RADIUS.

Dr. F. J. Cotton of Boston, Mass., has an article in the Annals of Surgery for August, entitled "The Pathology of Fracture of the Lower Extremity of the Radius." The article is richly illustrated with cuts and radiographs showing some of the many varieties of fractures that occur near the wrist joint.

One of the radiographs shows unmistakable touching a custom which should not be practiced unless specifically mentioned. It is very seldom a good thing to touch a negative for the reason that it is impossible to imitate the radiographic shadow.

In speaking of the shadow picture Dr. Cotton says: "It may be said in advance that there seems to be no single form of lesion described from any actual specimen, which is susceptible of demonstration in the shadow-picture, that has not been so demonstrated in one or more clinical cases; nor has the x-rays discovered any previously undescribed lesions. He further says: "Valuable as the x-ray is, it is obviously not the best basis for scientific classification of lesions." Again he says: "It needs no argument to show that the x-ray plate, valuable as it is, is in many ways a rather imperfect record."

Dr. Cotton has drawn conclusions for the matter of his paper after examining "specimens as have been available for examination, on description of plates of other specimens, on autopsy reports, on cadaver experiments by the writer and on other such experiments found recorded."

In studying this valuable paper it is clearly seen that the writer has been largely persuaded in his opinions from the many schematic plates that have been before him; and the sayings of the fathers of surgery have led him to deceive himself in the interpretation of the radiographic plates. It is true that the careless taking of a shadow-picture is a poor record, but it is also true that a radiograph taken with the distortions corrected (distortion by position and normal distortion) gives a perfect record—a record for accuracy that can not be had by any other known means. Without these distortions corrected it is impossible to know at what point in the picture the direct rays impinged upon the subject. When this is known and so indicated by impervious section on the plate, the interpretation of the radiograph is possible. It cannot be insisted on too strongly that in making radiographs a given diameter must be fixed which should be at right angles with the subject. When thus made dissection can not furnish so perfect information.

The x-rays may not have furnished other than "previously undescribed lesions" of the lower and of the radius and ulna. Such discovery is not needed. It has furnished us with the knowledge, that instead of one ulna styloid being broken in twenty Colle's fractures, as previously taught, there are three in five such fractures. This is of great clinical importance. It has also taught us the knowledge of undisplaced fractures of the lower end of the radius, a matter far reaching in clinical results. It has given us a method for positive diagnosis, which was, before, sometimes impossible to obtain. It has given us an exact means for determining the condition of the fracture after dressing.

With the x-ray we can "base conclusions as to details for scientific classification of

lesions." The shadow-picture is not schematic, if made according to known unerring rules. Arbitrary diagrams, together with the weight of former evidence, cannot alter the truth.

MISSOURI SCHOOL FOR THE BLIND.

An official notice has been sent out by the officers of the Missouri School for the Blind calling attention to this as being the only institution in the state where "all who need the aid we offer" may come. This is the institution that furnished us with blind patients for x-ray test, amongst whom many totally blind were able to observe light and shadows.

Parents and guardians of blind children in Missouri should not neglect an offer to educate their children. It is a state institution and there is no money profit whatever to the managers to increase the size of the class but the spirit of duty actuated the call.

Application Blank.

ROENTGEN SOCIETY OF THE UNITED STATES.

APPLICATION FOR MEMBERSHIP.

I hereby make application for membership in the Roentgen Society of the United States.

Signed .....

Full name.

P. O. Address.....

$5.00 must accompany each application. There is no initiation fee. The official organ, "THE AMERICAN X-RAY JOURNAL," free.

DR. J. RUDIS-JICINSKY.

CEDAR RAPIDS, IOWA.

We desire to correct typographical errors that occured in the valuable article by Dr. Alex. L. Hodgon, entitled "A Fluorescent Lead" in Vol. 6, No. 1 of the AMERICAN X-RAY JOURNAL, on page 695 Lumiere Voire is correct, 697 Lumire and Skiodomska is correct.

NEGATIVES DEVELOPED IN LIGHT.

Prof. F. E. Nipher of the Washington University, St. Louis, Mo., has discovered a method for developing x-ray plates in light. While photographing electric sparks and developing the negative the thought was suggested that x-ray plates might be developed without the use of the dark room. Experiments made were highly successful. These plates are shown to be negative when they were exposed to x-ray light provided they were enclosed in black paper, but they were positive if exposed to light while the x-ray was acting. If the proper time for an x-ray exposure should be one second and the exposure was continued sixty seconds and then developed in light an excellent picture can be produced which would be positive.

Professor Nipher used in developing the pictures hydroquinone but other developers may act as well. An incandescent lamp is the best to have in the room, as the degree of light can be regulated by moving to or from the lamp.

Fogging is an indication that the plate should move nearer the lamp. If already fogged a plate can be thus cleared up. Loss of detail indicates that the lamp has been too near the plate during the entire developing. It is better to start at some distance from the lamp, say six feet and with a weak developer spend an hour if necessary to obtain the sharpest details. With this method the plate can be watched during the course of development and the desired features brought out by pushing or arresting the operation.

Prof. Nipher told the writer that he expected to report further progress at which time the degree of light and distance the light should be from the plate would be approximately given.

The photographic plates made by the professor number into the thousands and some show the finest detail we have ever seen in photography. These were exposed first several days to light in a room, and

then exposed for street scenes several hours. One strange thing about these pictures is that moving objects as street cars, vehicles and persons walking on the street are not seen. A very good account of Prof. Niphers discoveries is given in the Electrical Review, London, Eng., but the most complete report is from the author himself in a paper contributed to the Transactions of the Academy of Sciences of St. Louis, Vol. X, No. 6.

We are in receipt of a catalogue of the "Atlantic School of Osteopathy," Wilkes-Barre, Pennsylvania, where Doctor Wm. Smith is announced as president of the faculty. Doctor Smith was formerly from Kirksville, Mo., where he gained for himself an enviable reputation as a teacher in anatomy. We, however, desire to mention the fact that Doctor Smith was instrumental in having installed in Kirksville the highest grade x-ray apparatus and accessories together with the fluorometer. He took hold of the new science in conjunction with anatomy and taught for the first time in this country the anatomy of the invisible parts of the living being. The radiographs made by him of injected subjects, using Chinese vermillion specially prepared, are specimens of the highest art. A radiograph was made by him of the pelvis and thighs of an injected subject in which the minutest vessels stand out from the arterial trunks resembling the numberless branches on leafless trees. His work and ingenuity has been mentioned in publications that we call regular. It is to be regretted that Dr. Smith after having a scholarly and professional education in Europe did not pass regularly into the special sciences for his instinctive resources are rich and useful. His mind is eager, his soul is free and his heart is even larger than his big body. When a man in public office suffers the retributive consequences of high place it is laid to his wife that "she had the brains" Mrs. Smith is a beautiful charming woman but both man and wife have grace culture and mentality. We hope Dr. Smith's enthusiasm for x-ray work will find encouragement in his new home.

HOME MADE STATIC MACHINE.

Dr. Beard of Fruita, Colorado, has sent us some radiographs made with a home-made, one glass plate 19 inch static machine. The doctor says in his letter concerning the pictures and machine: "The machine is very crude. It shows what can be done, however, when the tube is adapted to the plates' action. I have given the plate 1,800 revolutions a minute as shown by speed indicator. I started out to see what speed the plate would stand but have concluded not to break it just yet." The radiograph of the wrist taken by this one plate machine is very good, showing the bones and articulations perfectly. The exposure was five minutes and the distance six inches.

DISCONTINUITY OF CATHODE RADIATION

An account of experiments showing that cathode rays may have a strong tendency to discharge themselves intermittently. Make a cathode beam rotate about its axis by means of a revolving magnetic field. While a continuous beam would then describe a circle on a fluorescent screen, a cathode beam only produces a series of patches arranged on the circumference of a circle. When the tube is worked by an alternating current, each active semi-period is thus broken up into a series of equidistant discharges. — First abstracted in London *Elec.*

Ferdinand Ernecke of Berlin, S. W., Koniggratzerstr 112, has issued a catalogue entitled "Roentgen Apparate." The large folder includes more than 50 pages and is richly illustrated with all the forms of coil apparatus used to generate x-rays. Every accessory is also pictured making nearly 100 cuts in all. The description of the new interrupter alone is worth the cost of obtaining one of these catalogues.

ANSWERS TO INQUIRIES.

B. G.—BECQUEREL RAYS are radiations proceeding from substance, without the existence of known energy, and having the property of the Roentgen rays. The name is taken from Becquerel who demonstrated the independent existence of the rays in contradistinction to the observations of Henry made in 1896 to the effect that the eminating rays from sulphide of zinc were transformed x-rays. This supposition was made because the material giving off the rays had been exposed to the x-rays. These rays will produce photographic effects six inches but closer proximity is necessary to get hand shadows and metal shadows through the hand. The bones are not made visible.

Uranium having the highest atonic weight of the metals was selected by Becquerel to produce radiation, i. e., the phosphorescent compounnds of uranium was used.

The pure metal, however, produces the radiation in greatest abundance and therefore, Becquerel called the new radiation "Uranium Rays." The name has been abandoned because other substances are known to be stronger radiators.

Madame Curie, of Paris, discovered a substance one hundred times stronger in radiation than the Uranium and Tharium compounds previously known. Bohemian pitchblend was discovered by Madame Curie as having greater radiation than uranium ore and this had been the element found in pitchblend which was supposed to give off Becquerel rays.

She had the active conetitutents of pitchblend isolated and discovered therein two products—compounds of bismuth and barium but with the strange difference that the compounds of the same found in other ways did not emit Becquerel rays. These products were mistaken for elements and were named "Polonium" and "Radium" whereas they were simply alotropic forms of compounds of bismuth and barium. You may read in literature upon this subject the name "radio-active bismuth" and radio-active barium" which means in effect the same thing.

Eister and Geitel has succeeded at the chemical laboratory of A de Haoen, of List, near Hanover, in making concentrated preparations of these substances, that exceed anything hitherto produced in radio-activity. It requires several hundred pounds of the ore to obtain a few grains which practically prohibits its general use. A very much cheaper product is made and with but slightly weaker radiations. These rays can be used to excite the same screen used in Roentgen rays. Hopes are now about dispelled of using radio-action substances for obtaining diagraphs of the human body.

T. S. J.—Nerves absorb the x-rays with about the same degree as flesh; large arterial trunks more than flesh because of the constituents of blood and their motion.

P. J.—I do not know of any radiograph having been taken of a foetus prior to bony formation.

A. C. K.—The X-Ray Stereoscope is a surgical instrument. With it the observer can locate a foreign body with greater certainty than with the fluoroscope. Messrs. Newton & Co., of London, England are making a stereoscopic fluoroscope designed by Dr. Mackenzie Davidson.

Isenthal & Co., 85 Mortimer Street, Cavendish Square, London, W., have recently issued an instructive catalogue entitled, "Radiographic List." The catalogue is printed on coated paper and the pages are embelished with cuts of the various types of coil machines, tubes, interrupters, Wimshurst machines and accessories used in x-ray work. The types of interrupters are especially interesting. A complete price list of all this reliable house has to sell is appended.

THE DOWNFALL OF THE ATOMIC THEORY.

The relation the atomic theory may have in explanation of inter-tubal phenomena can be better appreciated when Thompson's theory is understood. It is for this reason we print from the Electrical Review, of London, March 2d, 1900.

"At the beginning of the present century Dalton laid the foundation of the atomic theory of chemistry. The belief in the chemical atom has become more firmly established by the physical and chemical investigations of the century, and this atom has till recently successfully resisted all assaults on its indivisibilty. But the remarkable paper read by Prof. J. J. Thomson at the last meeting of the British Association, and published in the December number of the Philosophical Magazine, puts forward evidence which makes it almost impossible to doubt that the atom of the chemists can no longer be looked upon as the smallest indivisible particle of matter, but is actually split up into very much smaller particles in certain well known physical processes. If this theory is firmly established it will revolutionize the 19th century views on chemical and electrical theory, which by their total failure to explain the phenomena of the recently discovered Reontgen rays and of electric discharge in rarified gases, had begun to prove themselves effete.

Faraday was the first to show that the quantity of a given metal deposited in an electrolytic cell was proportional to the quantity of electricity which passed through the solution. This quantity of metal is also proportional to the atomic weight of the metal divided be its valency, i. e., the number of chemical bonds set free by the decomposition of the molecule. In the form given to it by Helmholtz, Faraday's law states that the same quantity of electricity passing through an electrolyte either sets free or transfers to other combinations, always the same number of valencies. In his Faraday lecture delivered in London, in 1881, he made the following important induction from Faraday's law: Every single valency of an elementary or compound ion is charged with exactly the same quantity of positive or negative electricity which behaves as if it were an electric atom that cannot be further divided. This amounts to saying that every active chemical bond of a chemical element is associated with the same constant quantity of electricity.

Prof. J. J. Thomson has extended the theory of Helmholtz by the remarkable discovery that when the elementary electric charge, or "electric atom," is negative, it is always associated with a small constant mass of matter, very much smaller than the atom of the chemists. These small masses or "corpuscles" with electric charges actually exist separately from the chemical atoms in the cathode rays, and in other cases where negative electricity is discharged through rarified gases.

Prof. Thomson describes his remarkable hypothesis as follows: "I regard the atom as containing a large number of smaller bodies which I will call corpuscles; these corpuscles are equal to each other; the mass of a corpuscle is the mass of a negative ion in a gas at low pressure—i. e., about 2×10^{-26} of a gramme. In the normal atom this assemblage of corpuscles forms a system which is electrically neutral. Though the individual corpuscles behave like negative ions, yet when they are assembled in a neutral atom the negative effect is balanced by something which causes the space through which the corpuscles are spread to act as if it had a charge of positive electricity equal in amount to the sum of the negative charges on the corpuscles. Electrification of a gas I regard as due to splitting up of some of the atoms of the gas, resulting in the detachment of a corpuscle from some of the atoms. The detached corpuscles behave like negative ions, each carrying a constant negative charge, which we shall call

for brevity the unit charge; while the part of the atom left behind behaves like a positive ion with the unit positive charge and a mass large compared with that of the negative ion. On this view electrification essentially involves the splitting up of the atom, a part of the mass of the atom getting free and becoming detached from the original atom."

This remarkable theory will modify our ways of looking at many electrical phenomena. In electrolysis, for instance, when the anions and cations are liberated against the electrodes, the ions with the positive charge are minus the negative corpuscle and are neutralised by a corpuscle moving from the electrode to the ion, while the ions with the negative charge are neutralised by a corpuscle passing from the ion to the electrode. The corpuscles according to this view are the vehicles by which negative electricity is carried from one atom to another. It would appear that there is only one kind of electricity, namely, negative; positive electricity being due to the atom being short of negative corpuscles.

The effect of solution upon an electrolyte is, according to Arrhenius, to dissociate the molecules, *i. e.*, the chemical bond which unites the two atoms forming the molecule is torn asunder. This chemical bond, according to the theory we are now considering, is the negatively charged corpuscle. This bond, for some reason not understood, adheres to the electro-negative atom, and leaves a corresponding empty space in the electro-positive atom. This circumstance makes the chlorine negative and the hydrogen positive. The negative electric charge on the cathode means an accumulation of electric corpuscles on its surface, while the positive charge on the anode means an accumulation of corpuscle cavities near its surface. The result is, that hydrogen is attracted to the cathode, and chlorine to the anode, but the transference of electricity is due to the passage of the corpuscles from atom to atom throughout the electrolyte. Conduction in metallic conductors probably takes place in the same way, but as the corpuscle has no greater attraction for one set of atoms more than another, there is no transference of the normal atoms along the conductors. In dielectrics, something prevents the corpuscles being transferred from one atom to another.

The number of corpuscles which can be detached from an atom by any known process is never greater than its valency or the number of its chemical bonds. It does not, however, follow that the part left behind does not contain more corpuscles which might be detached by more powerful means. The Zeeman effect, in which the lines of the spectrum are split up by the action of a magnetic field on the luminous substance, is explained by assuming that rotating particles of the substance, having an electric charge, are accelerated or retarded by the force exerted on these charged particles by the magnetic field. The ratio of the mass to the charge as determined by this effect is of the same order as that which has been deduced for the corpuscles, and hence the vibrating particles which produce the lines of the spectrum are probably the corpuscles of the atom. This view is further confirmed by the fact that the explanation of the Zeeman effect requires that the particles be negatively electrified. Now there are a considerable number of lines in the spectrum which show the Zeeman effect, and the presumption is that there are a considerably number of corpuscles in the atom of the substance giving this effect

The ingenious experiments by which Prof. Thomson proves the existence of negatively charged corpuscles with mass very much smaller than that of the smallest chemical atom, will be found fully described in his paper in the Philosophical Magazine We propose here merely to briefly describe the nature of these experiments. Prof. Thomson had previously determined (Phil. Mag., October, 1897) the

value of the ratio of the mass, m, of the ion to its charge, e, in the case of the stream of negative electrification which constitutes the cathode rays. The results of this determination which were confirmed by subsequent determinations by Lenard and Kaufmann, showed that the value of this ratio was very much less than that of the corresponding ratio in the electrolysis of solutions of acids and salts, and that it was independent of the nature of the gas through which the discharge passed and of the nature of the electrodes. Of course, the smaller value of $m\,e$ in the cathode rays might be due either to the mass of the particles being smaller, or to the electric charge on each being greater.

As it did not appear feasible to determine m or e separately in the case of cathode rays, experiments were made on a similar phenomenon, namely, the discharge of negative electricity from a metal plate under the influence of ultra-violet light. Elster and Geitel have shown that the rate of escape of negative electrification at low pressures is much diminished by a magnetic field when the lines of magnetic force are at right angles to the lines of electric force. In this case a negatively electrified particle detached from an electrified plate by the action of ultra-violet light, is acted upon by two forces, namely, the electric force normal to the surface of the plate, and an electro-magnetic force which is always normal to the direction in which the particle is moving. The effect of the magnetic field is to cause the particle to follow a curved path, like a projectile, and come back to the surface of the plate from which it started. The path is not, as in the case of the projectile, a parabola, but a cycloid.

After the gas in a tube has been dissociated by an electrical discharge, a negatively electrified luminous ring rotating round the lines of force is produced by a varying magnetic field. The negative corpuscles being of much smaller mass than the postive ions, are much more easily set in motion by the electro-magnetic forces; hence negative electrification of the ring.

The electrification of air by the splashing of drops of water which has been so thoroughly invested by Lenard may find its explanation in this theory. The negative corpuscle attached to the atoms of oxygen is probably separated from the atom by the solution of the air in water, so that the mere mechanical shattering of the drop is sufficient to set free the corpuscle with its negative charge. The electrification developed in this way is always negative unless a certain percentage of salts is dissolved in the water, when the electrification is positive. Evidently in the latter case some of the atoms of these salts retain the negative corpuscle and set free its positive atomic partner. The whole obscure question of the origin of atmospheric electricity will probably receive considerable elucidation from the electric corpuscle theory.

The evidence on which Thomson's theory is founded is so strong that it will be hard to upset; and if it stands, there can be little doubt that it is the beginning of a new era in chemistry and molecular physics.

Polonium Rays.—S. CURIE.—An account of an investigation of the penetrative power of Polonium rays. With Roentgen rays the absorption weeds out all but the rays of greatest penetrative power, but with Polonium rays it is just the contrary. Polonium rays do not penetrate the air at ordinary pressures farther than about 1½ inches, or about the same distance as Leonard rays; those radium rays which are not deflected by a magnet behave exactly like polonium rays. It is difficult to discover any law, of absorption in radium rays by themselves, as they consist of two species of rays obeying different laws of absorption. It is possible that these different laws indicate a fundamental difference in the nature of the deflected and undeflected rays.—*Comptes Rendus*, Jan. 8; abstracted in Lond. *Elec.*, Feb. 23.

THE ROENTGEN RAYS WITH ASSOCIATED PHENOMENA AND THEIR APPLICATION IN DENTISTRY.

The above is the title of a paper recently read before the Ohio State Dental Society. by W. A. Price, D. D. S., of Cleveland. The doctor says :

"If we are to use Roentgen rays successfully, and intelligently, we must familiarize ourselves as much as possible with the nature and characteristics of this wonderful force. This knowledge is not only desirable but imperative. We can best do this by comparison with other similar forces with which we are familiar. Let us look for an analogy; some similar imperceptible transference of force or energy. You hear my voice, how ? Sound is conveyed by a succession of waves. The pitch or tone is dependent on the rate. Let us recollect in passing that the sense of hearing makes us conscious of all vibrations in the atmosphere from sixteen per second to thirty-two thousand. But this energy requires an easily detected medium to travel upon. It cannot come to us through a vacuum.

Another of our senses receives energy which we call light. This may vary in color. Again we are receiving vibrations of varying rapidity and the rate gives us the particular color. Note that this energy passes easily through a vacuum. We call them light waves.

Still another sense receives impressions without any trace of the medium that brings it, namely, sensation of temperature as we feel heat, and cold or the absence of heat. This energy we know as heat waves, and it also passes through a vacuum.

So also a mysterious energy entirely imperceptible in itself, enters chemical compounds and entirely changes them. For example, bromide of silver in the photographic plate. This force we know as actinic waves. Equally mysterious and imperceptible is the force that moves the magnetic needle or marshals the iron filing; magnetic waves. All the latter pass through substance and through great space, even trillions and trillions of miles without an atmosphere or an apparent conductor. We cannot imagine effect without cause, nor can we imagine energy being conveyed without something to convey it. Heat and light, and magnetism coming from the sun or a distant star, must have a means for passage.

This medium, according to modern science, is the everywhere existing ether. It extends throughout all space between all planets, penetrating and prevading amongst the atoms and molecules of all substances, as the air does through a car load of pumpkins. If we follow up this line of thought just a litte farther we will get a very comprehensive idea of what Roentgen rays probably are. When your ear receives two hundred and fifty-six vibrations per second, you recognize the tone of the middle C of the musical scale. And just so with every definite rate of vibration you receive definite impressions.

Just as the different sounds are the result of definite vibrations in the atmosphere just so are magnetism, heat, light, color, photographic or photo-chemical effect and x-rays the results of definite vibrations or waves in the ether. Imagine waves in the ether having about such a motion and curve as the surface of water in a rolling sea. You can easily imagine various waves of the same shape flowing at the same rate but of greater or of lesser dimensions. These various ether waves flow at a quite uniform rate, viz., approximating one hundred and ninety-two thousand miles per second, (Tyndall) though for each effect we call magnetism, heat, light, color, photo-chemical action, etc., there are different, though definite, length of waves, and hence numbers of waves per second. The variety is enormous; from waves over a million miles long for a complete oscillation, as the magnetic waves from the sun. (Oliver Lodge) which require

six and a half seconds for a complete oscillation, to waves one twenty millionth of an inch long, (Veller) making two hundred and eighty eight thousand trillion vibrations each second. (Veller's calculations for x-ray.)

Intermediate between these we are able to recognize a large number of distinct waves' lengths, though relatively few considering the wide range. The sense of sight recognizes only a short series of wave lengths less than one octave, from one thirty-nine thousandth of an inch long, producing red light to one fifty-seven thousand five hundredth of an inch long producing violet light. Practically all the other waves that produce effect upon the human eye, have lengths between these two boundaries.

The lengths of the other waves determine entirely the color they produce by falling upon the retina of the eye. Time only permits of one example here. We will now have the professor at the lantern, place a prism in front of the light and you will see the distribution of the seven primary colors of the solar spectrum, or in this case the spectrum of the lantern light, though not so plainly as you would from an arc light. The relation of these light-producing waves to other ether waves is shown in this lantern slide (Fig. 1). Without explanation we note that other waves of various lengths each has a different angle of refraction in passing through this prism and in this way we are able to separate and select them. This is true also of those waves on each side of the visible spectrum. Kindly note that all the waves longer than the infra-red or shorter than the ultraviolet do not appeal to the sense of vision, and to do so must have their wave lengths or periods changed to come between those limits. This we do with the Roentgen rays by means of the fluoroscope. The wave lengths are changed in the crystals, which we will explain shortly.

To better understand the nature of the Roentgen rays we will observe quickly some characteristics of some waves of other lengths. In the lower part of the visible spectrum and extending down through four octaves of wave lengths we have the heat waves. One simple experiment will suffice. I pass the waves from this arc light through this filter made of carbon bi-sulphide holding iodine crystals in solution and remove all the light rays and then condense the remaining rays with this lense, and I am able to set this paper on fire or heat this platinum to a white heat. The relation of the light rays to the heat-producing rays can best be appreciated by this lantern view (Fig. 2) showing the relation of the heat rays to the light rays from the sun after passing through the moisture of the atmosphere and this slide (Fig. 3) the relation of the heat rays of an electric arc to the light rays. In each the dark part from A to D C indicates the relation of the heat waves and their intensity below the visible spectrum and C D to E shown clear the spectrum from red to blue, and the heat waves therefrom, the line A B E indicating the intensity. You will observe that fully eight times as much of the energy of the arc light is given off in heat rays as in light rays. In the next (Fig. 4) we see the relation of many wave forms to each other and to sound waves.

The waves of longer period or length do not appeal directly to any of our senses but we know that they exist from their effects. Marconi and others have invented eyes, to see as it were, some of these waves of other lengths. That is the function of the receiver or co hearer used in wireless telegraphy. I have here arranged a working model. When I set these brass balls of this induction coil about an eighth of an inch apart and cause a spark to jump across, it is probable that the vibrations produced in the surrounding ether are at the rate of about sixty million per second the waves being possibly a few miles from crest to crest. The wave length used is not known. You notice that as soon as I produce waves of this certain period this

co-hearer receives them and closes the circuit of this battery which I have arranged by means of a relay to ring a bell. To show you how little effect distance has I will have someone carry it away through the building behind walls, etc. The model worked splendidly, so far as taken, responding each time the coil was excited, by this means Marconi has signalled ninety miles.

In a similar way wireless telegraphing, or signalling, is done at a great distance by waves of still greater length, magnetic waves, which we have not time to consider.

Ether waves of very short length, extending away above the visible spectrum into the so called ultra-violet rays, including the Roentgen Rays, have the power of producing extensive chemical changes. Chief of these are the actinnic rays so important in photography. You will see when I put this bottle of bisulphate of quinine in the ultra-violet part of the spectrum it glows. It is due to this power that we are able to use the Roentgen Rays. We allow these invisible rays to penetrate the tissues to be examined and some of the rays are arrested or stopped according to the obstruction offered by the different parts of the field through which they pass. thus producing unequal chemical action on the plate. Hence the term shadowgraph. This hypothesis of ether waves of extreme frequency explains very clearly and plainly, practically all the phenomena of Roentgen Rays. There is another theory, that of material particles being thrown off by the anti-cathode which pass through the glass of the tube unobstructed. This theory is not so generally accepted. Its chief supporters, however, are Americans.

The doctor further in his paper discusses the various methods used to generate the currents and the tubes from which he obtains the best light. The paper is concluded with radiographs, which will be followed in our October issue, with descriptions.

BOOK REVIEWS.

FRACTURES, by CARL BECK, M. D., Visiting Surgeon to St Mark's Hospital and to the New York German Poliklinik; formerly Professor of Surgery, New York School of Clinical Medicine; Consulting Surgeon, Sheltering Guardian Society, Orphan Asylum, etc., with an appendix on the practical use of the Roentgen rays. 178 illustrations. Price, $3.50 net. W. B. Saunders, Publishers, 925 Walnut street, Philadelphia.

The only words on the cover of this book are: "Fractures" "Beck." This rare simplicity upon a book cover invites an interview.

The paper is heavy and coated throughout, a selection unique in book making, a practice that must be followed in medical works to accommodate the new science. The frontispiece is a radiogram of a patient's feet and legs taken for comparison showing one fractured and the other intact. Subjoined is a brief history thereof. This introductory picture is a radical change from the time-worn pictures of fathers and authors. The book is dedicated to Roentgen "without whose discovery much of this book could not have been written."

In his preface Dr. Beck has had an exceptional opportunity to give cogent reasons for writing a book. It is the first systemic treatise ever written for the student and practitioner wherein portraits of internal organs are made of the living. The anatomic findings have been verified by exposing the fractures in their living state The author says "The illustrations in older works were mainly made from the cadaver. The splendid schematic representations that resulted were not portraits from life. The minute arrangement and disarrangement of fragments of splinters, especially in their relation to the joints were necessarily disarranged by even the most careful dissection. The Roentgen rays depicts these details and all others undisturbed as they are in life. It is with these that the surgeon has to deal.

In the introduction Dr. Beck touches upon the physics of the science and then plunges into the diagnostic advantage of the rays in various types of fractures.

One of the traits of the book is simplicity and freedom from verbosity. There is no figurative language except an occasional simile used for emphasis. When a technical phrase is used it is immediately followed with parenthetical explanation When a description is of the plain tongue technical parenthetical clauses follows. It is thus that the book becomes easy to read, easy to understand and the best possible mode for imparting education It is a rest to be able to read a book on fractures so free from complicating phrases.

The general plan of the book is in two parts and an appendix. Part one covers Fractures in General, and includes Classification of Fractures. Statistics, Signs, Diagnosis, The Process of Repair, and the Formation of Callus, Disturbance in the Process of Repair. Treatment, Peculiarities of Fractures in Children. Part Two—Fractures of Special Regions. Fracture of the Shoulder and Upper Extremity—Clavicle, Scapula, Humerus, Forearm, Hand and Fingers. Fracture of the Pelvis, and the Lower Extremity—Pelvis, Thigh, Patella, Leg, Foot. Fracture of the Bones of the Trunk—Ribs, Sternum, Spinal Column. Fracture of the Skull—Vertex, Base, Facial Bones.

The appendix. The Practical Use of Roentgen Rays. Errors of Skiography, Index.

The skiagraphs are exceedingly good, reduced as they are in some instances many diameters. They are distinctive for teaching. In making up the 178 illustrations nearly half of them represent the style of fractures as seen in ordinary text books by unaided means. Immediately beside each of these is a skiagraph of the same subject viewed in the same plane showing the ana-

tomic condition in a "living picture." These side by side pictures act as a revelation to guide the careful doctor in his trying mission.

Dr. Beck has written the first book ever written upon the subject of fractures, in which is portrayed the abnormal condition of the surface of the patient overlying the fracture together with the abnormal condition of the bone as it actually is when brought to the surgeon. False, doubtful and ambiguous teaching the result of former guessing will be replaced with confidence and accuracy by those who will read this book. All other works on the subject of fractures may be laid aside as relics of obsolete literature. Dr. Carl Beck has in one stretch encompassed the field and given us light in the midst of darkness.

Skiagraphic Atlas.

Showing the Development of the Bones of the wrist and hand, for the use of students and others by John Poland, F. R. C. S. Published by Smith, Elder & Co., 15 Waterloo Place, London, Eng. Price $1.25.

This book contains nineteen radiographs of hands and wrists all of which are actual reproductions and of normal size. They represent ages ranging from twelve months to seventeen years. These radiographs are interesting because they show ossification of the bones of the wrists and hands at different periods of infancy and adolescence. An explanatory page accompanies each picture. The first begins with: "*Lower end of ulna.*—There are no traces of calcareous material yet visible in the cartilaginous lower epephysis, while the diaphysis is rounded, slightly curved with convexity inwards, and its end is flat and almost exactly on a level with that of the diaphysis of the radius." Then follows description of lower end of radius, carpus, metacarpal bone of thumb, four inner metacarpal bones, phalanges of fingers first row, middle or second row, unequal or terminal phalanges. This same completeness of study obtains through all the radiographs up to the seventeenth year, when the bones seem fully formed.

This contribution to the study of anatomy is unique, most valuable, and must establish a new text for the student and practitioner. It is an invaluable guide to the doctor who treats fractures and joint injuries, who must know the normal conditions before he can hope to recognize abnormal ones. The book is well bound, well printed, and the half-tones are on heavy coated paper.

Biography of X-Ray Literature and Research.

By Charles E. S. Phillips. The Electrician Printing and Publishing Co., Ltd., 1, 2, and 3 Salisbury Court, Fleet St., London, Eng.

This little book has about 100 pages in all. The frontispiece is a cluster of well-known faces of some of the x-ray workers—Roentgen, Crookes, Lenard, Lodge, Righi, Elihu Thomson, J. J. Thomson, S. P. Thompson.

Very properly the book opens with a retrospect or brief historical sketch of the x-ray advance done by Guericke, Mollet, Faraday, Geissler, Maxwell, Masson, Sir W. Thomson, Gassiot, Sprengel, Hittorf, Goldstein, Warren de la Rue, Hugo Muller, Spottiswoode, Croakes, Wiedemann, J. J. Thompson, Hertz, Lenard, Perrin, Elster, Geitel, Roentgen or the history of the works of these physicists who paved the way for the final discovery of the x-rays.

The title and price of all books devoted to x-ray science and also all titles of important papers are given in alphabetic order. The little book is well and handsomely bound.

Food Theory of Medicine.

Walter Emery Merrill, M. D., U. S. Marine Hospital Service, says: "Among the advanced members of our profession, I believe the drug tissue—feeding theory no longer obtains. And rightly so, for it has not been proved that medicine is ever, *in itself*, a food. The large number of malarial cases emanating from the tropics are cured in the Marine Hospital service, not by tissue-feeding, but by ridding the system of the intruder and directing the vital forces along the lines of repair. This I find to be best done by the frequent and judicious administration of laxative antikamnia and quinine tablets."